An Integrated Playful Music Learning Solution

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Abstract. This paper presents an integrated solution using IT technologies to help a (young) musician learn a piece of music, or learn how to play an instrument. The rehearsal process is organized in sequences, consisting of various activities to be 'passed'. Several games are investigated that help in learning especially difficult parts, or in the learning of an instrument. The integrated solution, demonstrated on a tablet, proposed in this paper also includes tools that assist the musician in the rehearsal process. Feedback consists of computer tracking that supports self-assessment of rehearsal quality together with shared audio and video material that can be viewed by teacher and peers.

Keywords: Informal learning · Music rehearsal · Mobile applications · Gamification · Low-fidelity prototyping

1 Introduction

Recent developments in the theories of music learning point to the need for new tools to aid the learning processes of musicians. Drawing on insights from research in music pedagogy, the integrated digital toolkit proposed in this paper aims to provide especially young musicians with means for receiving feedback, and allow for playful interaction between musician and technology. For instance, part of the integrated solution is a game where the musician gets points for notes while playing, thereby simultaneously providing feedback to the music student and allowing for playful interaction [1, 2].

Younger music students typically learn music in a semi-autonomous environment [3, 4] in which the teacher interacts with the student less than half an hour a week, and the student works alone [5] most of the time, or with the help of family, e.g. on homework given by the teacher, or via self-motivation. The limited teacher interaction set-up is, however, potentially demotivating and can result in many errors on behalf of the student [6]. Errors can include forgetting what is to be played, as well as lack of expressiveness, e.g. when the score is seen as an exact representation of the music. It requires a high skill-level for a musician to be expressive on his or her own. The lack of organization and attention to expression in the traditional music school scenario is potentially harmful for the apprentice musician.

In addition to individual one-to-one teaching, many music teachers use group teaching, in which several students work together. While this enables more active participation, logistic problems often impede on the added motivation [3].

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In addition to the lack of learning due to miscommunication and other errors in the environment, the students may lose self-belief and self-efficacy (conviction of success), which is one of the key characteristics needed in order to be a successful musician [7]. According to [8], formal music training increases the self-assessment score, and this internalization of the evaluation process increases self-efficacy, hence the need for supporting and enhancing self-assessment.

McPherson [9] investigates skill development in music pupils. Five main skills are acquired when learning music: performing rehearsed music, sight reading, playing from memory, playing by the ear and improvising. In a large-scale study with 7-9 year old music pupils, improvements were found in all categories in three consecutive years. These were explained mainly by four strategies, organizational strategies, order of practice, practicing to improve and self-correction strategies. For all the skills, the strategy employed was a significantly more powerful indicator for the improvement than was the hours of practice. Conversely, lack of mental strategies can therefore be expected to impede on a pupil's progress in music learning.

Play as such has been studied as a learning resource, combining imagination and cognition at the same time, by researchers such as Bateson [10], Vygotsky [11], and Apter [12]. According to these researchers, players enact their play, reflecting upon the implications of their actions as in reality. E.g. [11] propose that children playing with tangible toys are transported to an imaginary world, in which they practice conceptual thinking, exploring what actions they could take and their implications. In the context of ECML, the integrated games can, in particular, enable serious musical performance attempts (i.e. in performances outside the game), e.g. in relation to parallel octave shifts on the piano, difficult key fingering in wind instruments, etc. Similarly, games helping musicians practice music theory can be made by transposition knowledge methods [13], in which knowledge is obtained by a user via interaction with seemingly disparate games into which relevant information has been inserted.

2 State of the Art

Several applications for aiding musicians in their learning process already exist, both for regular computers and portable devices. Apple's lite digital audio workstation, Garage Band [14] (available on both iOS devices and Mac) has long been able to offer step-by-step video lessons for purchase, where the user can then easily record his or her feedback within the program for later reference. The process of sharing such recordings with others, as well as a classic "music minus one" approach where the musician can play or sing along with accompaniment and practice sheet music are integrated into the iOS only app Tunemio [15]. However, neither of these platforms offers the gamification aspect, which ECML includes.

If one expands the scope of applications to involve platforms for collaborating on music as such (and not necessarily on the music learning process), many communities exist, such as those around the multi-platform services Indaba Music [16] or Kompoz [17], both of which offer social network style environments, in which music projects have 'pages' where collaborating users can upload sound files, lyrics, sheet music and other elements for use in a song, as well as comment on the process. Similar collaboration processes take place on the sound sharing service Soundcloud [18] (which, however, is nowadays also used by record companies to promote signed artists) and comparable platforms. A flashier collaborative tool is the iOS-based WholeWorldBand [19], which allows users to add tracks (in the sense of layers) to the songs of other users by means of video files, thereby gradually generating a multi-splitscreen music video.

What distinguishes ECML from the aforementioned platforms is the integration of collaborative tools, tools for music learning targeted towards the individual user, especially to aid the rehearsal process and the link between rehearsal and music lesson (with the music student's teacher), and again, the gamification aspect.

3 Design and Development

The target platform for the design of ECML is tablets, given the consideration that the integrated solution should be easily portable (as the music student usually shifts between different rehearsal spaces) and afford online communication with teachers or fellow students. Mobile devices in general, iOS, Android and Windows-based alike, make it possible to synchronize information quickly between users, in this case making it easy to ensure that e.g. a teacher's advice or other information for the student passes on effortlessly and stays up-to-date.

Another aspect of the tablet, as opposed to the smartphone or similar small mobile devices, is that the size of it (typically the size of a piece of paper or a book page, even though exact sizes vary) is sufficiently close to that of a traditional, physical piece of sheet music, to make the transition from rehearsing a piece of notated music via physical sheet music to rehearsing with the aid of a digital platform, as seamless as possible. For the present version of ECML, an Android-based tablet was used.

3.1 Design

In order to develop the initial ideas for the application further, a low fidelity prototype was used. This consists in designing the application in a paper version. The advantage is that it is easy to create functionalities at the conceptual level and test these in practice by moving pieces of paper. Thus, subjects see exactly what the ideas would look like in practice, and modifications are made directly. An example of the use of a low-fidelity prototype is seen in Fig. 1.

In order to assess the quality of the prototypes better, another approach used in the development process is the creation of scenarios, observations of, and interviews with apprentice musicians using the ECML in a given scenario. The chosen scenario presents the main functions of ECML: first a general presentation with the basic options (selection of a song, choice of instrument, play button…), secondly other useful options (metronome, tuning fork, access to Youtube, Facebook…), then the games, and finally the ECML messenger. Another created scenario focuses on the sequence of activities. The knowledge gained from this process is used in the iterative development process. An early prototype from this process is seen in Fig. 2.

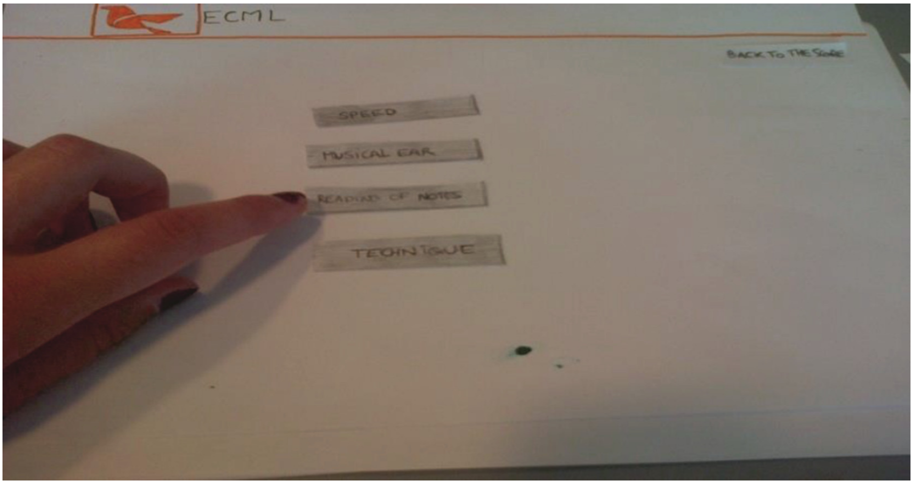

Fig. 1. Low fidelity prototype with interaction

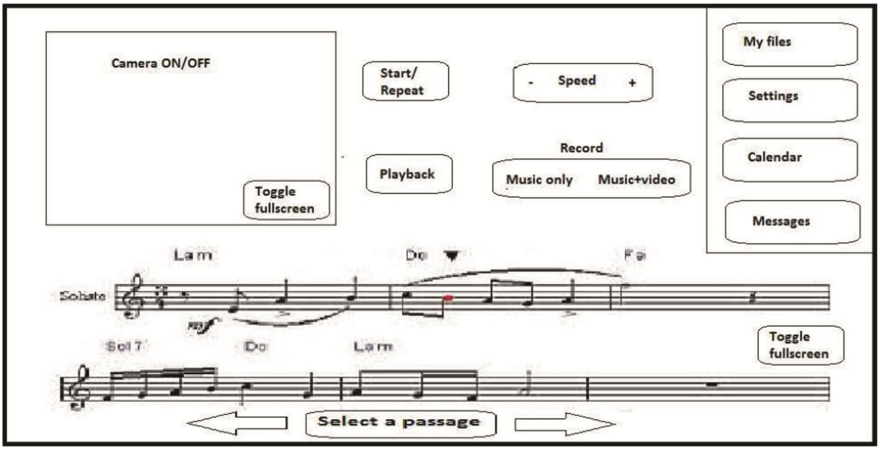

Fig. 2. Low-fidelity prototype of integrated solution

As general strategies for designing the games in ECML, the following basic principles from Salen and Zimmerman [20] were used:

- The game has to have clear goals
- The game has to have clear feedbacks
- The game must include challenges but not too hard

Also, the games had to be fun, but still supporting the main goal of learning to play an instrument or a piece of music. It was decided to base the game on the individual personal experience of learning music. A group of university interns helping with the development of ECML provided examples of exercises typically given to them by their own music teachers. These examples were transformed into different games. There are different levels in each game and the generic goal is to reach a higher score. To pass a level, the player has to reach a minimum score. For each game, the player has to first select a section of the song that he is playing. The team of interns first suggested 4 different games:

- "Speed": the goal is to play a part of the song as quickly as possible
- "Musical ear": the goal is to recognize the notes by ear
- "Note Reading": the goal is to learn to read the notes quickly and correctly
- "Technique": the goal is to play the part of the song with different rhythms

As stated above, the games as well as the integrated solution were developed using an iterative process using low-fidelity prototypes. Some examples of the relationship between the low-fidelity prototype and the final software version for one game can be seen in Fig. 3.

One example of the developed games, the note reading game, can be seen in Fig. 4 (screenshot from the end of one game).

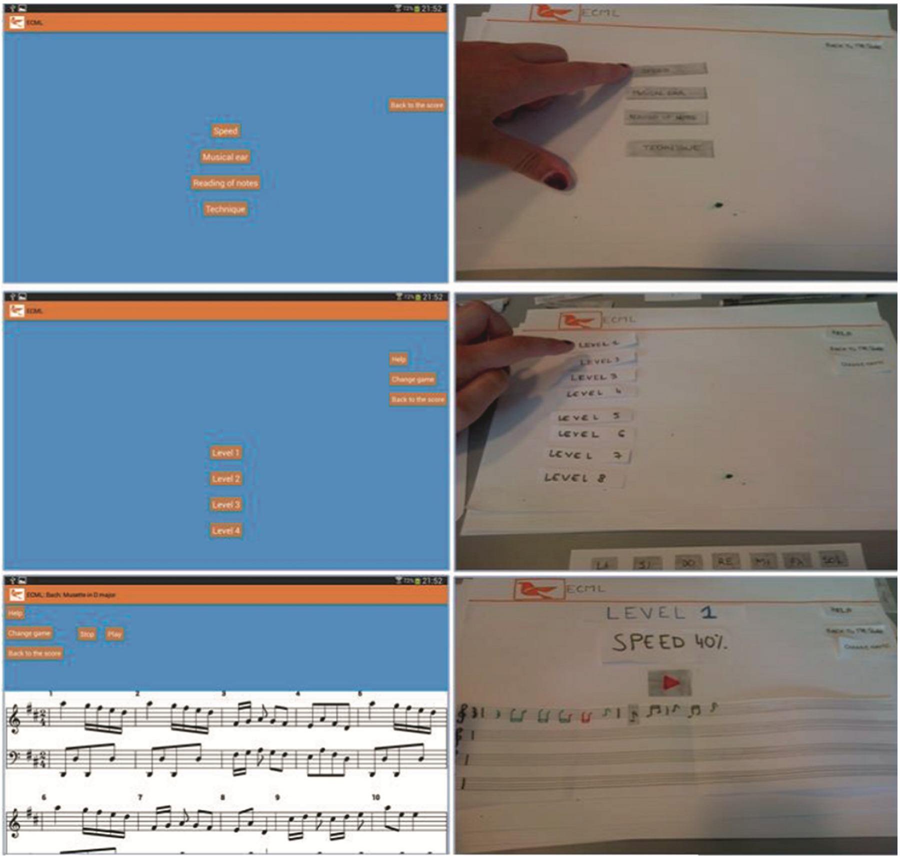

Fig. 3. The final version compared to the low-fidelity prototype for some functions of the software.

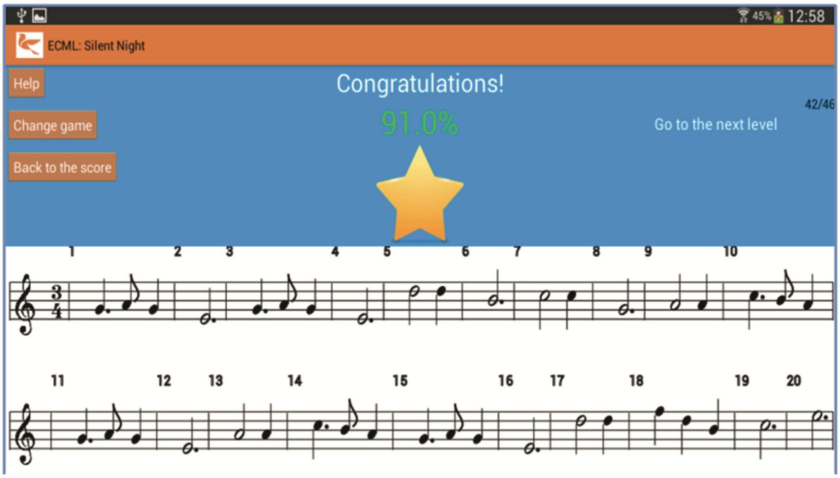

Fig. 4. Example of a learning game, the note reading game

3.2 Development

The development of ECML has been an iterative approach, with an initial low fidelity prototype, an early software prototype and a final beta version. About half of the development team had extensive music background (more than ten years) and many of the functions included were suggested and/or improved upon in the weekly meetings between the developers and the project responsible.

Functions developed started with notation visualization, calendar, communication, and games. The functioning prototype looked similar to the paper prototype of Fig. 2. Then an organization approach was initiated, and the sequence of activities was developed, along with music learning and practice games, and common music functionalities such as audio and video recording, metronome and tuning fork. The final version can be seen in Fig. 5. Other functionalities implemented include a mute button and delay before notation starts, so as to enable preparation time.

ECML is implemented on Eclipse [21] using the built-in Android Developer Tools. The main elements of this approach are the manifest (all the essential information about the application, permissions, main activity and the first activity to be launched), the layout (either statically in XML or dynamically), the menu (view and items in XML), the values (String (application name and other string variables) and Assets (files that will be included in package) and sources (Java files).

The development has been done with the Agile methodology [22], as it is often used in software development to enhance productivity, in respecting the Model-View-Controller architecture. This pattern separates the different components inside the architecture of the application. According to the discussions in the development team and information from low-fidelity prototypes, and from observations using the developed scenarios, an iterative approach, using information from the low-fidelity and scenarios experiment, has been taken, and development consists of bug fixes, feature additions and new functionalities.

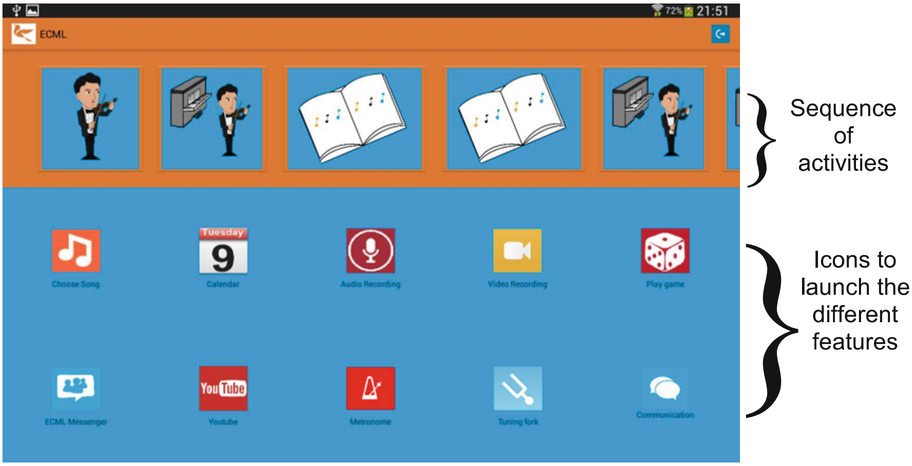

Fig. 5. Final prototype of integrated solution.

The final integrated solution, dubbed ECML (Easy Coach for Music Learning) organizes the rehearsal process in sequences, consisting of various activities to be 'passed'. Activities are, for instance, warm-up, note-studying, playing from sheet music, and games, the latter to provide variation and opportunities for playful learning. Several games have been made that help in learning especially difficult parts of a piece of music, or in learning how to play an instrument as such. As an example, pianists often consider moving in parallel octaves difficult. If the note-following functionality detects many errors in this part, it is suggested that the player tries an associated game to improve upon this skill. Another example could be if the tracking mechanism detects errors in the musician's playing in relation to the sheet music: in this case, a game exists with this specific part of the music, having the musician perform the part correctly, gradually increasing the speed. ECML also includes tools that assist the musician in the rehearsal process, such as a calendar (for agreements, meetings, etc.), tools for communication (with the teacher, other musicians etc.), video (in order to observe an expert or studying one's own progress), tuning fork and metronome. Feedback consists of computer tracking that supports self-assessment of rehearsal quality together with shared audio and video material that can be viewed by teacher and peers.

4 Evaluation

A questionnaire was created based on the Technology Acceptance Model [23], [24] and the System of Usability Scale [25] in order to study the potential acceptance of the ECML application and its usability. The goal of this questionnaire was to evaluate the level of acceptance of the application by musicians, an evaluation made in the light of different hypotheses (what can influence the intentions of the musician to use the application). The questionnaire was given to students at the conservatory of Esbjerg. After careful examinations, it was decided to divide the questionnaire into three parts: The first part

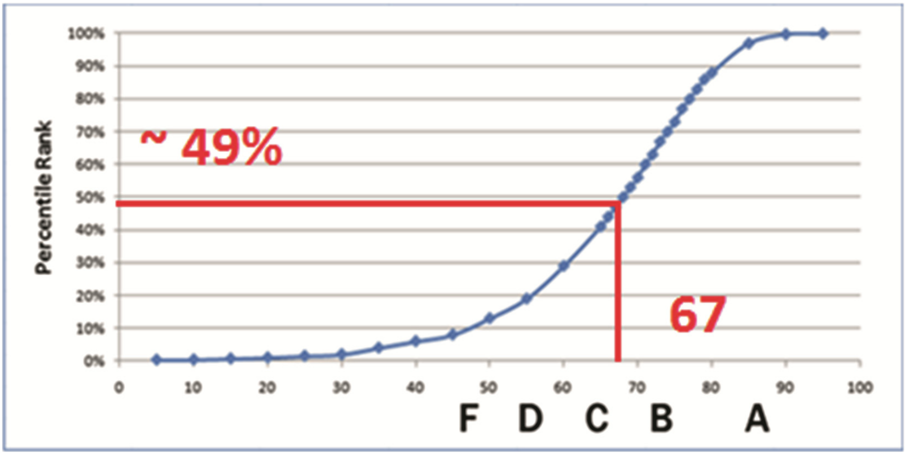

Fig. 6. System of usability scale score of the ECML prototype

is based on TAM and its aim is to collect some information about the perception of ECML. The purpose of the second section, which is based on SUS, is to evaluate the usability of the application. The third part is targeted towards the gathering of additional information on the habits of musicians, in order to improve the application, in other words, an element of actual interview in the, thus semi-structured, questionnaire.

Unfortunately, it was not possible to find enough subjects for the surveys. Consequently, only 8 interviews were conducted. Due to the limited number of responses to the questionnaire, the only reliable results are those coming from the second and the last part of the questionnaire consisting of SUS-score, which has been proven informative even for very small samples [26] using the qualitative documentation of the habits of musicians. The average result of the SUS-score is 66,9. In Fig. 6, taken from [27], we see the distribution of results from 500 SUS studies with different topics, for which the average score is 68, and 5 classes (A, B, C, D and F, alluding to the American grading system) defined for the usability of the scores (given in percentage on the y-axis). Plotting the score from the present SUS-questionnaire onto the graph, we see that it falls in class C: for the eight interviewed people, the ECML application is usable at approximately 50 %. This means that the usability is at this point acceptable (average), but could still be improved.

5 Conclusions

This study shows the iterative process of developing an integrated music learning tool. With an extensive literature survey to obtain information about habits of music students and the requirements of music students and music teachers, several defining aspects of the music learning tool was found. These include structuring and motivating the students, and making sure all necessary information about the current rehearsal topic is available, the attention to the development of different skills when learning music, and the variation of learning methods with both formal and non-formal (games) learning.

All the information from the literature survey was used in an iterative design development with low-fidelity prototyping, scenarios, observations, interviews and questionnaires, rendering several functioning prototypes. The final prototype has basic functions (metronome, tuning fork, notation), sharing functions (audio and video recording and sharing, calendar, messenger), learning games and organization function (sequence of activities). Initial experiments indicate this app provides valuable functions to music students but more work is necessary before this can be assessed with certainty.

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References

1. Price, S., Rogers, Y., Scaife, M., Stanton, D., Neale, H.: Using tangible to promote novels forms of playful learning. Interact Comput. **15**, 169–185 (2003)
2. Price, S., Rogers, Y.: Let's get physical: the learning benefits of interacting in digitally in augmented physical spaces. Comput. Educ. **43**, 137–151 (2004)
3. Gaunt, H.: One-to-one tuition in a conservatoire: the perceptions of instrumental and vocal teachers. Psychol. Music **36**(2), 215–245 (2008)
4. Kurkul, W.W.: Nonverbal communication in one-to-one music performance instruction. Psychol. Music **35**(2), 327–362 (2007)
5. Austin, J.R., Berg, M.H.: Exploring music practice among sixth-grade band and orchestra students. Psychol. Music **34**(4), 535–558 (2006)
6. Rostvall, A.L., West, T.: Interaktion och kunskapsutveckling. En studie av frivillig musikundervisning. KMH förlaget, Stockholm (2004)
7. McPherson, G.E., McCormick, J.: Self-efficacy and music performance. Psychol. Music **34**(3), 291–309 (2006)
8. Seddon, F.A., O'Neill, S.A.: How does formal instrumental music tuition (FIMT) impact on self- and teacher-evaluations of adolescents computer-based compositions? Psychol. Music **34**(1), 27–45 (2006)
9. McPherson, G.E.: From child to musician: skill development during the beginning stages of learning an instrument. Psychol. Music **33**(1), 5–35 (2005)
10. Bateson, G.: Steps to an ecology of mind. Jason Aronson Inc., Northvale (1972)
11. Vygotsky, L.: Mind in Society. Harvard University Press, Cambridge (1978)
12. Apter, M.: Reversal Theory: The Dynamics of Motivation, Emotion and Personality. Oneworld Publications, Oxford (2007)
13. Marchetti, E., Jensen, K., Valente, A.: Transposition of Domain Knowledge into Educational Games. Int. J. Technol. Knowl. Soc. **9**(4), 273–288 (2014)
14. Garageband (2015). https://www.apple.com/mac/garageband/ Accessed on 4 February 2015
15. Tunemio (2015). https://itunes.apple.com/fi/app/id849934448 Accessed on 4 February 2015
16. Indabamusic (2015). https://www.indabamusic.com Accessed on 4 February 2015
17. Kompoz (2015). http://www.kompoz.com Accessed on 4 February 2015
18. Soundcloud (2015). http://www.soundcloud.com Accessed on 4 February 2015
19. Wholeworldband (2015). http://www.wholeworldband.com Accessed on February 4, 2015
20. Salen, K., Zimmerman, E.: Rules of Play. Game Design Fundamentals. The MIT Press, Cambridge (2004)

21. Eclipse (2015). https://eclipse.org/ Accessed on 5 February 2015
22. Agile Manifesto (2015). http://agilemanifesto.org/iso/en/principles.html Accessed on 5 February 2015
23. Davis, F.D.: Perceived Usefulness, Perceived Ease Of Use, And User Acceptance of Information Technology. MIS Q. **13**(3), 319–340 (1989)
24. Shroff, R.H., Deneen, C.C., Ng, E.M.W.: Analysis of the technology acceptance model in examining students behavioural intention to use an eportfolio system. Australas. J. Educ. Technol. **27**(4), 600–618 (2011)
25. Davis, F.D.: User acceptance of information technology: system characteristics, user perceptions and behavioral impacts. Int. J. Man Mach. Stud. **38**, 475–487 (1993)
26. U.S. Dept. of Health and Human Services (2006). Web page summarizing *The Research-Based Web Design & Usability Guidelines, Enlarged/Expanded edition*. Washington: U.S. Government Printing Office. http://www.usability.gov/how-to-and-tools/methods/system-usability-scale.html Accessed 4 February 2015
27. Sauro, J.: Measuring Usability With The System Usability Scale (SUS) (2011). http://www.measuringu.com/sus.php Accessed on 4 February 2015